

SOLVE GEOLOGIC HAZARDS SOONER RATHER THAN LATER

Over the 30-year span of my career in the Denver area, I have seen sites developed that would not have been considered economical even a few years earlier. This phenomenon occurs in all fast-growing areas. Geologic hazards may have been one reason why these sites were previously avoided.

In 1974, the Colorado House of Representatives passed House Bill 1041, which requires geologic hazards and mineral resources be considered in planning land use. As a result, the Colorado Geological Survey defined geologic hazards to include avalanche, landslides, rockfalls, mudflows and debris fans, unstable or potentially unstable slopes, seismic effects, radioactivity, ground subsidence, and expansive soil and rock.

Our most common hazard is expansive soil and rock, which affect most sites east of the Colorado Front Range. As residential development continues to the edges of the Denver Basin and beyond, we are seeing an interest in more steeply sloping sites, which may incur any or all of the first six hazards mentioned above, and sites that were previously undermined, usually for coal or clay. The regional hazards of seismicity and radioactivity typically affect all sites to some extent and are fairly easily remediated.

Most municipalities have adopted guidelines that require developers to perform surveys to identify the existence of geologic hazards. Geo-hazard issues are sometimes not adequately handled in the planning process. When builders are faced with building on a site that may contain geo-hazards, it is always better to solve the problems sooner rather than later.

Slope hazards are becoming more common. The forces of gravity, wind and water, combined with chemical weathering, continually work to make the world flat. Climate change has occurred many times over recent geologic time, with both wet and dry periods. Most geologists agree that in the period about 8,000 to 10,000 years ago, the Denver area was much wetter and cooler than now, which resulted in some extensive landsliding on clay slopes. Because of the changes that take place over time, it is often difficult to identify old



landslides by typical features. Old landslides are fairly common in Denver's western suburbs. Sloping sites containing clay soils may be prone to instability that can show as slow creep or even landsliding, particularly if the slopes have moved previously.

We have seen instances of creep on slopes as shallow as about 15 percent to 20 percent where highly plastic clay is present. Slopes underlain by sand, sand and gravel, or sandstone are typically stable at steeper inclinations – up to about 50 percent, possibly more. Clay soil and claystone bedrock can lose strength upon wetting, which is an inevitable result of development and the progression from sun-baked dry prairie to lush, landscaped estate. Man-made slope embankments also can develop stability problems.

To avoid problems with clay slopes, we suggest conservative site design, including properly designed earth retaining systems when modest slope inclinations cannot be accommodated, good site drainage practices, erosion control and reduced irrigation near slopes, elimination of structures such as decks near steep slopes, and implementation of land development procedures such as cutting benches into existing slopes to be filled. When working in sloping terrain, you should engage an experienced professional to identify hazards and provide mitigation recommendations. 🏠

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